# RENEWABLE ENERGY SOURCES IN CZECH REPUBLIC RELATED WITH INTEGRATION TO EU

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**SUMMARY**

*This article deals with the future growth of renewable energy sources in Czech Republic respecting the power obligations in face of the European Union. It describes the present legislative conditions and gives the advices for their future changes. The main part takes care of wind energy.*

*The questions of utilizing the renewable energy sources renewable energy sources are in our country highly up to date. With the entrance to EU, we have singed up for future increasing of renewable energy sources share on the general power production.*

***Keywords:*** *renewable energy sources, power system, wind energy potential, wind turbine, environmental impacts*

## 1. INTRODUCTION

The plan of "Czech power conception" is the following growth of that share from approximately 2% present-day:

by the year 2010.....upon 8%
by the year 2030.....upon 11% to 13%

It results of these particulars that between years 2010 and 2030 RES will not belong to the basic power supplies in Czech Republic (CR), but their utilization will have a significant regional contribution. According to experts evaluation the aim of first period can be fulfilled especially with higher utilization of small hydropower plants, of wind turbines (WT) and above all with higher utilization of biomass. It is assumed an annual power production about 930 GWh of WT, in the year 2010.

It has proved, that the biggest development of wind power is in countries, where was realized a system of minimum redemption prices of electricity for a longer time. Such a system is used in most EU countries and also CR assumed it. For the fulfilment of indicative aims, it is also necessary to create a support system, whereby creates at known high capital expenses an atmosphere for investors.

Another expected development of RES should have generally take place as a consequence of Kyoto memorandum-reducing the emissions of greenhouse gases.

## 2. EVULATION OF LAWS IN FORCE

The questions of support in RES utilization are so far in Czech law regulated by:

- Power law: The support proceeds as follows:
  a) producers of electricity from RES have a priority right of connection into power system
  b) electricity produced by RES have a priority right of transmission and distribution
  c) power system operator is liable, if it is technically possible, to buy the electricity from RES
  d) by price statement of Czech power regulation office were fixed the floor redemption prices for electricity, supplied to power system by RES (tab. 1)

| Type of RES | Price for 1 kWh in Euro (exchange rate from 20.2.2004) |
|---|---|
| Small hydropower | 0.047 |
| Wind turbine operated before 1.1.2004 | 0.093 |
| Wind turbine operated after 1.1.2004 | 0.084 |
| Biomass | 0.078 |
| Biogas | 0.078 |
| Geothermal energy | 0.093 |
| Photovoltaic | 0.187 |

**Tab. 1** Floor redemption prices of electricity from RES [1]

- Energy conservation law: The support is implemented as follows:
  a) regional power conception must contain an evaluation of RES efficiency
  b) government passes the "National program of economical energy treatment and exploitation of its renewable and secondary sources", valid for four-years,for realization of the program, may be granted subsidies from national budget

Furthermore, the RES manufactories of electricity are by other enactments free of income tax, namely for the five years of their commissioning.

These valid enactments however don't guarantee the performance of our power aims, to whereby we

have signed up. New enactment is therefore inevitable.

## 3. POSSIBILITIES OF FUTURE DEVELOPMENT

According to experiences from EU is a RES dynamic development still strong dependent upon the supports of national governments. They must create a legislative ambit and economic instruments for reaching the objectives. The policy, when the power companies were responsible for the exploitation of RES, wasn't widely successful. The effective supporting programs must be clearly established and durable in long-term perspective. At the same time they must be enough motivating, but on the other side enough strict – designed only for serious investors.

Single EU countries have chosen the various support attitudes. Mostly are the power companies liable for supplying a certain rate of electricity from RES, but they aren't liable for providing the grid connection at one's own expense.

Price setting mechanisms: A system of "green energy" allows to consumers to pay higher prices for energy from RES. The power company then promises, that a profit of this mark-up will use on a development of ecological energy. This program is from last year established in CR too.

Tax programs: One of the possible solutions is to reduce price discrimination between RES and fossil fuels by implementation of a "carbon tax". RES are free of this tax and at the same time they have a reduced VAT (value added tax).

Investment grants: In CR is possibility to gain a grant or a soft loan. Some countries however gave out from the investment grants and instead of begun to lay stress on the tax programs.

To most successful belong the systems of aerial supports, combined with the unlimited duration of tax relief. Distribution companies are liable for paying up to 90 % of average price for electricity from RES per consumer. Furthermore the law allows a reimbursement of "power" and "carbon tax". These customs will sooner or later have to become valid in CR. Every member state can have the best suitable way of supports, EU doesn't determine it strictly.

## 4. POTENTIAL OF WIND ENERGY IN CZECH REPUBLIC

The possibilities of wind energy in territory of CR are in no case able to confront with the possibilities of seaside countries. It is given by a continental position of the country and by complicated aerographical conditions, which decrease the wind speeds and make choppiness. Though, it is clearly not to say that in territory of CR it is impossible to exploit wind energy. Some locations, which aren't too little, have the potential easily comparable with wind conditions in Denmark. A primary criterion for location suitability is of course the wind speed. For the lowest value, whereat is the exploitation of wind energy still economic, is considering the speed of 4.5 m/s. Locations, where the average annual wind speed exceeds 6 m/s are excellent.

With the power potential of wind energy deals for years in CR an institution of atmospheres physics of Science Academy in Prague. According to its studies, the possible exploitable wind potential is possible to estimate at 700 MW to 1000 MW, and annual production at 1.5 TWh to 2.5 TWh. From the above mentioned studies comes-out a map in fig. 1 [5], where are marked the locations with possibility of building-up wind turbines. Consequently, the actual state of wind power utilization in CR (0.01TWh per year) doesn't match a technical potential of the territory.

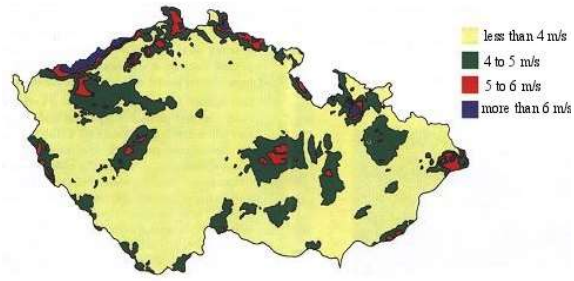


**Fig. 1** Wind map of CR

The largest and the most optimal locations in CR are uniquely situated at the extensive territory of Krusne Hory Mountains, in northwest of CR near the Germany frontier. There can be looked at the average annual wind speed of 7 m/s, which comes-out from long-term observations.

## 5. WIND FARM "CHOMUTOV" IN KRUSNE HORY MOUNTAINS

One of the major up-to-date projects in a sphere of RES will be a build-up of wind farm near city of Chomutov [6]. Selected locations are situated just at the plateaus of Krusne Hory Mountains. These territories up to 950 metres above sea level are characterized by the sufficient wind energy potential [6]. For 70 % to 80 % of the year blows here a wind, which can be used for driving wind turbines. Wind speeds vary here in annual average between 6.0 m/s and 7.5 m/s. The project takes into account with up to 96 wind turbines. Next, these most considerable areas are analysed:

1. wind turbines
2. distribution system of the project
3. evaluation of environmental impacts

### 5.1 Wind turbines

Power production will be realized from WT with rated power from 1.5 MW to 2.0 MW. These are the technologically advanced and efficient wind turbines

from Danish (NEG Micon) and Germany-English (DeWind) provenance. The parameters of both types are in table II, the power characteristics are in figure 2 [3, 4].

| | NEG Micon NM72C/1500 | DeWind D8/2000 |
|---|---|---|
| Rated power [kW] | 1500 | 2000 |
| Hub height [m] | 80 | 80 |
| Rotor diameter [m] | 72 | 80 |
| Gearbox | planetary/spur gears | planetary/spur gears |
| Generator | fixed speed induction generator, 4/6 pole | double-feed induction generator, IGBTinverter |
| Nominal wind speed [m/s] | 15 | 13,5 |
| Tip angle regulation | active stall | pitch |

**Tab. 2** Parameters of WT

Safety and minimum risk of these modern WT result also from their security toward an icing (by blades warming), the lightning effects (by sophisticated grounding) and the gusts (by automatic cutting-off). A crucial issue is the warming of blades and so removing the icing, which occurs very often in Krusne Hory Mountains. An optimization of running these wind turbines is provided with the optimal orientation against the wind direction and with the regulation of optimal tip angle position.

It will be installed totally:
58 pcs. NM 72C/1500 = 87 MW
38 pcs. D 8/2000 = 76 MW
Total:
96 pcs. WT = 163 MW

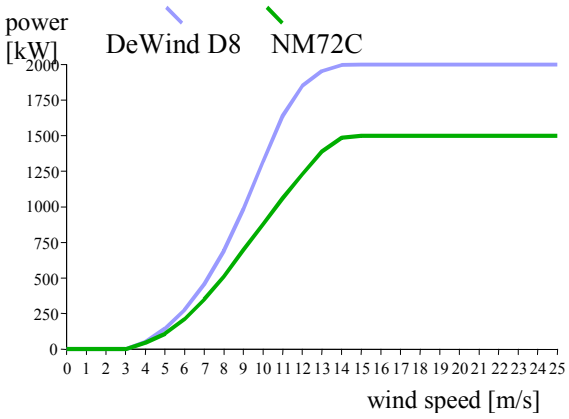


**Fig. 2** Power characteristics of WT

This installed capacity will have an annual electricity production of 458 GWh.

### 5.2 Distribution system

The distribution system is provided by:
- underground cable line of 110 kV backbone distribution - 22.3 km
- underground cable line of 30 kV - 98.5 km
  Total - 120.8 km
- distribution substations (110/30 kV)
  DS 1 – western circuit
  DS 2 – eastern circuit
- substation DS 3 (400/110 kV), which is situated near heat power plant "Prunéřov"

The distribution system build-up is in this case necessary, because current system of proper distribution company is in this area little developed. It was drawn only for the supplies of mountain resorts, thus its capacity is fully used. The plan of project has its own distribution structure, solved with 10 % to 15 % of backlog, which enables connection of other participants. Smooth power distribution is assured by agreement with the Czech power company, namely with harmony of power law.

Each WT will be situated in locations, which are necessary to make accessible for traffic. It is assumed the build-up of service communications, which enable the transport of construction materials, and technology of WT and during the following operation a smooth maintenance service.

### 5.3 Evaluation of environmental impacts

In a scope of advanced workings was made an ecological evaluation under the law of examination the environmental impacts. In terms of the process were investigated all influences, which will occur during the build-up and subsequently during the operation. The most significant are noise studies, studies of landscape impacts and of fauna and flora impacts.

Noise studies: They were objectified all possibilities of noise generation, especially of noise during build-up and during operation. In phase of build-up it is possible to expect, that the noise emitted by goods traffic demonstrably satisfies the hygienic limits. During operation the dominant sources of noise with markedly lower intensities will be the individual WT. The sound pressure levels were calculated in places of nearest sites, which all as well suit the hygienic requirements.

Landscape and tangible properties impacts: A definition of landscape pattern is based on aesthetic qualities, which have markedly subjective character, and on natural appreciation, which is possible to objectify easily. In case of this project, the natural funds of the territory will not be touched. WT will be throughout the landscape scattered, so that they will not create any conglomerate. The tangible properties and nor no cultural relics will not be touched by the construction. The investor also takes

into account the financial compensations, paid to appropriate villages.

Impacts on flora and fauna: A dominant fact is that all built-up area is situated on agricultural lands, which most has permanent herbage. Construction impacts on flora will be then minimal.

The whole area has good conditions for the existence of considerable animal kinds. Any immediate conflict with individuals is not expected due to a character of surrounding area, which forms a biggish zone. Experiences from abroad argue that birds easily adapt on movement and noise of WT. Everything indicates that no one of continual bird lane in this territory will be affected by the construction.

In terms of the project it is assumed, that in section of WT production plant in city of Chomutov will be created new job opportunities during build-up and during operation of the whole system.

## 6. CONCLUSION

Power generation with the utilization of renewable energy sources today already successfully competes with the conventional sources. Also Czech Republic is able to contribute to constantly increasing percentage of green electricity generation. The necessary condition is however to ensure a cohesion between legislative and economic tools in supporting the renewable sources.

## REFERENCES

[1] Czech Republic parliament, “Improvement suggestions for year 2004,” Law of supporting renewable energy sources, 2003. (in Czech)

[2] Czechventi Inc., “Wind farm Chomutov,” Project brochure, 2003

[3] DeWind, “Wind turbine brochure D8,” available at www.dewind.de.

[4] Neg Micon: WT brochure NM72C/1500

[5] Novák, P.: Use of wind energy in Krusne Hory region, Proceedings of the Conference on the Effective Use of Physical Theories of Conversion of Energy, Pilsen 2003, pp 93-98. (in Czech)

[6] Velek, V.: Wind power and economic efficiency in present state of Czech Republic, Proceedings of CIRED Conference, 2000, C-4: pp 24-31. (in Czech)

## BIOGRAPHY

**Jan Mühlbacher** graduated at Electrotechnical faculty of Mechanical and Electrotechnical university in Plzeň in 1980, where in 1987 finished his scientific postgraduate study (PhD.). In 1996 he was promoted as Associate Professor of Electric power engineering. From 1981 he works on West Bohemia University. First on the Department of Electrical Machines and then on the Department of Power Engineering and Ecology. He is an author of 1 monograph and 5 university textbooks and more then 50 scientific and professional papers mainly in foreign journals and proceedings. His specialisation is transient phenomena in electric networks, stability of synchronous machines and modelling of electrical network.

**Milan Nechanický** graduated at Faculty of Electrical Engineering, West Bohemia University in Pilsen in 2001. Now he is an internal post graduate (PhD.) student. Thesis title is “Stability of renewable energy sources in the electricity supply system”.